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A STUDY ON LANTHANIDE COMPLEXES AS POSSIBLE SINGLE-MOLECULE MAGNETS

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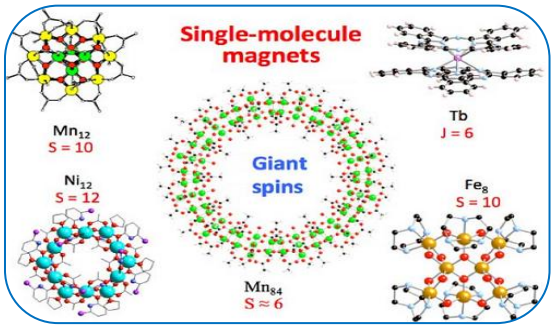
Abstract:

A range of lanthanide compounds with soft ligands or alcoholic ligands were synthesized and their magnetic properties were analyzed.These two compound groups have proven promising but not commonly studied as single molecular magnets; this work is to build on the field in which research is performed. Weaker bridging ligands have shown that super exchange interactions between metal centers increase marginally compared with harder ligands.



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INTRODUCTION:

The lanthanides are composed of things from 57 to 70 that form the first row of f block elements in the periodic table. The action of the 4f orbits normally allows lanthanides of similar chemistry, so they can easily be treated as a group.. Other Ln^{II} species are extremely unstable, with $[Cp(SiMe_3)]$ derivatives recently being published. Even in compounds like CeO_2 or $Ce(COT)_2$, Ce^{IV} is the most frequently found Ln^{IV} ion.[1-6]

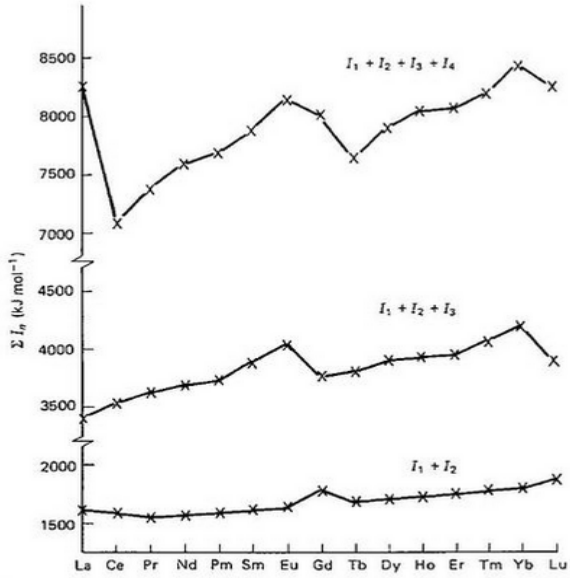

Figure1:Ionisation energies of the lanth anides[4]

Ionization energy in the lanthanides clearly explains the stability of the Ln oxidation states (Figure 1). The relative stability of Sm^{II}, Eu^{II} and Yb^{II} is due to the high value of the energy of the third ionizer in comparison to other lanthanides, and the energy of ionization for cerium is slightly lower in fourth position than any other lanthanide, and is the only +4 oxidation.

The yttrium-and-scandium metals are also rare earth elements since they are very close to the lanthanides in chemicals and physical properties.

Synthesis of Lanthanide Organometallic Complexes:

Salt metathesis is the most common forming of compounds due to the ionic nature of lanthanides . The response between lanthanide halide and alkaline metal-ligand salt forms the desired product with a strong side product of alkaline metal halide salt which is simple to extract for purification. It is not rare to integrate an alkaline metal into the structure which constitutes a 'ate' complex that cannot be desired. This work involves several reactions that are made exactly this way from the lanthanide chloride and sodium cyclopentadiene's of lanthanide cyclopentadiene [6-11].

$$LnX_3 + 3MR \longrightarrow LnR_3 + 3MX$$

$$LnR'_3 + HR'' \longrightarrow LnR'_2R'' + HR'$$

Origins and Measurement of Single Molecule Magnetism:

One single molecule magnet (SMM) is a molecule which, when it is removed, can be magnetised using a magnetic field. This is a quantic property of a single molecule instead of an interaction property in bulk material between several different units, as seen in traditional magnets like $SmCo_5$.Single molecule magnetism can be used in the fields of data storage and spintronics. The hard drive consists of encoding data into magnetic material domains; the grains within the material can be magnetized differently from their neighbors and binary data can therefore be processed.

LanthanideComplexesas Single Molecule Magnets:

Lanthanide complexes could be extremely well equipped with SMM materials. In a single metal center, depending on the lanthanide, there can be many unpaired electrons, giving high spin value potential.Dy^{III} with $^6H15/2$ ground state symbol and therefore the maximum m_J of the magnetic ground state value is ±15/2 is the most commonly used lanthanide of the SMM works. The single-ion anisotropy of lanthanides is however the most important thing, which allows the exploitation of this high spin value. The individual m_J values of the ground state of a Ln^{III} ion have their own angular dependency and thus their own favorite distribution of electron density .While the crystal field itself has no significant effect on the separation of the lanthanide electronic states, it is able to interact with the ground state so that these otherwise degenerated m_J energy levels are separated. In the design or analysis of lanthanide SMMs, that is extremely helpful to keep in mind.[12-13]The activity of the SMM is highly affected by the interaction of the distribution of the lanthanide's magnetic ground electron with the ligands around it. By determining the correct position of ligand, SMM properties can be significantly improved.

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